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BACTERIAL GROWTH "SPECTRUM" ANALYSIS

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1. METHODS AND APPLICATIONS

When certain bacteria are grown in shake cultures of specified mediums under greatly increased oxygen pressure they develop characteristic bands of growth varying in width, number, density and type, and often separated by clear zones. These appearances simulate in some degree the bands in a spectrum and I have, therefore, given them the name "bacterial spectrums." "Bacterial spectrums" vary in width and depth dependent on oxygen tension, the composition of the medium and its concentration. The majority of organisms studied have shown marked constancy in appearance, although changes in pH from 7.2 to 5.6 and variations in quantity of inoculum of 24 or 48 hr. culture from 0.1 to 0.3 cc. have produced minor variations in a few species.

Apparatus and Experimental

The medium is put up in 12-15 cc. shakes in bacteriological test tubes. Wasserman tubes may be used with proportionately less medium. The melted agar medium (0.75% agar throughout) is planted at 40-45°C. with 0.1 to 0.3 cc. of 24 or 48 hr. broth culture in duplicate. Tubes are immediately rolled several times between the hands and plunged into running tap water to solidify. Incubation is for 48 hrs. under a pressure raised to 60 lbs. with oxygen.

The oxygen apparatus consists of a heavy iron pressure chamber, of a size to fit the incubator and provided with suitable attached

gauge and valve for regulating gas. Oxygen is provided by a commercial tank. Care is taken that no oil is present in the apparatus since oil and oxygen may result in an explosion. Adjusted lids and valves must hold pressure for 48 hrs. if results are to be reliable. The apparatus is so simple that frequently the parts can be picked up in the laboratory and fitted by a machinist.

On removal from the chamber the depth of the "spectrum," its width, position and width of bands are measured, the growth is described and the "spectrum" photographed against a lighted, frosted glass background. A roll film camera with portrait lens so adjusted that a 1:1 image can be recorded is used. Black paper is pasted over the back of the camera (film holder removed) so that only a narrow slit of light contacts the film at each exposure. In this way by turns of about an inch of film 40-60 "spectrums" can be recorded to the film.

The following mediums all containing 0.75% agar and adjusted to pH 7.2 have been studied: (a) 0.2% nutrient broth Difco, (b) 0.1% nutrient broth Difco, (c) 0.05% nutrient broth Difco. Medium (a) with each of the following, 0.0005% methylene blue, 1% sodium chloride, ½% sodium lactate, ½% monobasic sodium phosphate, 0.1% sulfanilamide Merck, 1% cysteine hydrochloride Eastman also has been employed.

The following organisms have been studied: E. coli communis, B. subtilis, Staphylococcus aureus, Sarcina lutea, Serratia marcescens, Ps. fluorescens, Ps. aeruginosa, Aerobacter aerogenes, B. megatherium, Proteus vulgaris, B. niger, B. mycoides, Staphylococcus albus, Eb. typhosus, Proteus X-19, B. anthracis (nonvirulent), B. Flexner, B. Shiga, S. paratyphus, S. schottmulleri, S. suipestifer, S. enteritidis.

The aerobic nature of organisms with reference to a medium can be judged by allowing shake cultures to incubate at atmospheric oxygen tension. Some organisms grow only on the surface, others show a smooth surface with growth just below the surface. The latter often grow with difficulty on ordinary streaks owing to too much oxygen since unlike fungi (1) they are unable to invade the medium to find their optimum oxygen tension. Such difficulty of growth sometimes may result in abnormally scanty development and pleomorphic forms, a fault which can be corrected if optimum medium-oxygen relationship can be established at this site. Again, oxygen tension may not be adequate, in which case changes should be in an opposite direction.

Applications and Observations

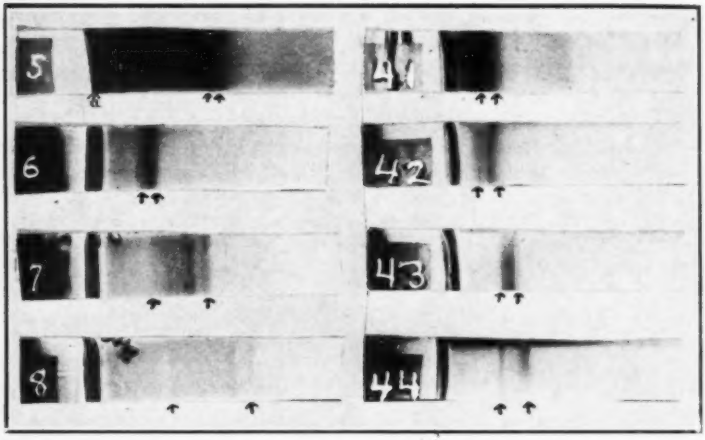
Depth of spectral growth increases with increase in oxygen

tension, and with decrease in concentration of medium for all organisms studied. Addition of certain substances as methylene blue (hydrogen acceptor) gave similar results for certain organisms studied. Width of spectrum (density of growth decreases) increases with decrease in concentration of medium; frequently this increase in width reveals new bands. Depth of spectrum decreases for reverse reasons and for certain organisms in certain mediums by addition of substances as cysteine (hydrogen donator). Three factors, determine variation (a) change in oxygen tension, (b) change in growth range (it remains to be proven if this is due to widening of optmum oxygen tension or/and Eh), (c) specific substance effect (it remains to be proven whether this is a hydrogen donator and hydrogen acceptor effect in a specific organism system). Therapeutic efficiency of drugs possibly may be explained in certain instances by specific substance effect demonstrable in the test tube. Our tissues are mediums and each has its oxygen tension. Organims demand a certain oxygen-medium relationship for growth; if drugs change this in infected tissues further growth and harm therefrom should be obviated.

There is evidence that at least some bands of the spectrum may be laid down in succession both in observations on 24 hr. growths under pressure and over periods of several weeks at atmospheric pressure in mediums with 0.5 gms. nutrient broth Difco. In the latter instance the laying down of as many as 8 successive bands has been observed. It seems the first line of growth occurs at the optimum oxygen tension or/and Eh with increased reduction below (demonstrable with methylene blue); apparently as by-products of growth accumulate and growth ceases, oxygen tension here increases over what it was formerly resulting in optimum oxygen tension 1-2 mm. below and another line of growth and so on successively. With decrease in medium concentration reduction effect on methylene blue becomes less marked and growth less compact, possibly with more easy diffusion of oxygen and broader bands. Organisms growing as diffuse colonies show little if any effect on methylene blue. A band of diffuse growth may be present at one level with a compact growth above or below. Further work is necessary to determine whether two lines of growth may occur simultaneously at different levels. If the latter is so it may be assumed that the organism has two different optimums of oxygen tension and oxygen tension variants exist.

The table gives growth spectrums of B. subtilis on the right and B. mycoides on the left. Five and 41 contain 0.2% nutrient broth and 0.005% methylene blue, and 6 and 42 this medium without

methylene blue. The light line as indicated by a in 5 is the surface of the medium from which measurements are made. Comparing the arrows (indicate growth) of 5 with 6 it will be noted that methylene blue markedly increases the depth of growth for this organism. Seven and 43 contain 0.1% nutrient broth and 8 and 44 0.01% nutrient broth. It will be noted spectrums become deeper and wider, bands appear and growth becomes more sparse as nutrient decreases. In 44 a clear space is noted. Some of the variation of intensity in 5 and 41 is due to oxidation and reduction and concentration of methylene blue.



Since this article deals in methods and applications, interpretations and relative literature on oxygen tension and Eh will be considered in a later paper. This seems advisable since there is much that is theory, requiring space for details. Other papers on the subject of medium and oxygen tension have dealt with fungi (1) and correlation in vivo and in vitro with respect to bacteria (2).

(1) The Difference in Growth of Pathogenic Fungi with Variation of Medium and Oxygen Tension. J. Lab. & Clin. Med. In publication.

(2) Bacterial Growth "Spectrums". II. Their Significance in Pathology and Bacteriology. To be presented at the meeting of the American Association of Pathologists and Bacteriologists, May 3, 1938.

Nutrient broth and agar from Difco Laboratories, Inc.
Methylene blue, medicinal. National Aniline and Chemical Co., Inc.
Oxygen, Airco, 99.5%.

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METHODS OF COLOR PHOTOGRAPHY*

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The use of color for illustrative purposes, dates back to the dim and distant past. Some of the mural paintings of the cavemen were in two colors. The old missals of the monks were decorated in exquisite colors; but these were paintings. The Japanese were probably the first to print in colors in superposition. It was not until about 1700 that color printing was introduced into Europe.

Sir Isaac Newton's discovery, about 1686, of the solar spectrum opened up vast fields of research including the whole field of reproducing in colors. Many of us associate Newton with the well known anecdote of Voltaire, the tale of the falling apple. How much truth there is in that story can never be known, but tradition marked a tree as that from which the apple fell and in 1820 when the tree was decayed and had to be cut down, the wood was carefully preserved. Newton was a great astronomer and mathematician, but he was also greatly interested in optics. He discovered the spectrum by his well known experiment of passing a small beam of white sun light through a glass prism by which means he obtained fan wise separation of the colors known as the spectrum, namely: violet, blue, bluish green, green, yellow, orange and red.

Jakob Christoffel Le Blon, was the first to make use of Newton's theory by printing from copper plates made in the seven spectral colors. Later in 1722, he concluded that all the colors could be reproduced by three plates with the colors red, yellow and blue. The plates were prepared in messotint, each representing all of one color, that is, one all the red, one all the yellow and one all the blue. He used transparent colors on white paper, scraping out the plates wherever there was white in the picture. A fourth or key plate was also prepared for the deepest shadows and some of the outlines. This process was very expensive, tedious and the composition of the colors depended entirely on the conception of the one making the plates. George Baxter, was at the same time working independently on a method of plate and block printing. He used as many as thirty blocks to reproduce the colors in his pictures.

About 1780 Alois Senefelder discovered the art of lithography quite by accident. He was an actor and author and spent much

* *Read before the American Society of Medical Technologists, at Atlantic City, N. J., June, 1397.*

time in the print shop helping to publish his works. He could not afford to pay for the engraving of his compositions so he attempted to do them himself. Copper plates were expensive and he had to grind and polish the few he had used previously. He had a piece of Kellheim stone to grind his ink on. One day he was polishing the stone and his mother asked him to write a bill for the wash woman who was waiting for the linen. Having neither ink nor paper he wrote the bill on the stone. Later when he was about to wipe the writing from the stone the idea came to him to try the effect of biting the stone with aquafortis. If the writing resists its action, impressions could be taken in the same way as from wood engravings. Surrounding the stone with a border of wax, he covered the surface with a mixture of one part aquafortis and ten parts of water. In five minutes the writing was elevated about one tenth of a line (1/12 inch). Then he used a thin piece of board covered with a fine cloth to apply the printing ink to the stone. This new method of printing was simplified and perfected by Senefelder and before he died in 1834 it was brought to comparative perfection. This was the beginning of superposition of colors in printing. But still there was the time consuming work of preparing the stones and the color composition still depended on the conception of the one making the stones. Lithographing today is carried out by the same process, except that perfect color pictures are now supplied by the author.

Grebe claims that Antonius de Dominis published a treatise in 1611 in Venice saying that colors were formed by the absorption of white light and that red, green and violet were the fundamental colors, from which the rest could be compounded. Later Aquilonius outlined a color scheme of red, yellow and blue as the primary colors and used half circles of the colors and suggested synthesis by these means. C. E. Winsch also propounded the theory of red, green and blue violet as the basis of color. But these earlier works seem to have been overlooked.

The first real step in the establishment of the theory of light was described about 1856 and is known as the Young Helmholtz theory. Hermann Ludwig Helmholtz born in 1821 was professor of physiology at Berlin and Heidelburg and worked on the physiological conditions of the impressions on the senses. The Young-Helmholtz theory held that all colors visible to the human eye may be matched by mixing the three primary colors, red, green and blue. Since this triplicity has no foundation in the theory of light, its cause must be looked for in the constitution of the eye. Helmholtz by one of those bold assumptions which sometimes express the result of speculation better than any cautious train of reasoning,

attributed the three color theory to the existence of three distinct modes of sensation in the retina, each of which he supposed to be produced in different degrees by the different rays. These three elementary effects according to his idea, correspond to the three sensations of red, green and violet and would separately convey to the sensorium the sensation of a red, a green and a violet picture, so that by superposition of these pictures the actual variegated world is represented. In order to fully understand this theory, the function which he attributes to each system of nerves must be carefully borne in mind. Each nerve acts, not as some have thought, by conveying to the mind the knowledge of the length of an undulation of light, but simply by being more or less affected by the rays which fall on it. The sensation of each elementary nerve is capable only of increase and diminution and of no other change. We must also observe that the nerves corresponding to the red sensation are affected chiefly by the red rays, but in some degree also by those of every other part of the spectrum, just as red glass transmits red rays freely, but also allows those of other colors to pass in small amounts. With this theory as a background, Clerk Maxwell, in 1861 showed experimentally that all colors visible to the human eye could be matched by the proper mixture of the three primary colors, red, green and blue-violet. Upon this idea, all the attempts and advances in color photography have been based. But before we discuss the development of color photography, let us review briefly the background and armamentarium upon which Clerk Maxwell could base his experiments on the first color pictures.

In 1732 J. H. Schulze discovered that silver chloride was darkened by light. In 1737 Hellot attempted to make inks which would be invisible when written but which could be made visible later. He discovered that ink made of silver nitrate would remain invisible until exposed to the light.

No important advances were made until 1802 when Thomas Wedgwood, a son of the most famous potter, published a paper, "an account of a method of copying paintings on glass, and of making profiles by the agency of light on nitrate of silver." Before this time, silhouettes had been made by cutting out black paper profiles and sticking them on white paper. Some of the silhouettists were very clever with their scissors, but those who were not so clever set their subjects in front of a white screen with a lamp behind so that a sharp shadow or profile was thrown upon the screen. From this they drew the image. Wedgwood's idea was to print the profile on the screen on paper which had been treated with silver nitrate. He then tried to use the "camera obscura" which consisted of a box with a lens at one end and a ground glass at the

other. The artists drew the picture produced on the ground glass. Wedgwood put his silver nitrate paper in place of the ground glass, but it was too insensitive to obtain any results. Sir Humphrey Davy used silver chloride and succeeded in making pictures through a microscope by using sun light. These first pictures made through a lens on photographic material did not last, as there was no means of keeping the silver nitrate from turning dark all over after part of it had been darkened for the picture. As Davy stated "Nothing but a method of preventing the unshaded parts from being colored by exposure to the day is wanting to render this process as useful as it is elegant." In England in 1819 Sir John Herschel discovered sodium thiosulphate or hypo. In 1839 he discovered that the unaltered silver nitrate could be dissolved away by "hypo" and the picture would be "fixed." To this day hypo is the mainstay of the photographer.

About 1814, in France, Nicephore Niepce discovered that resin or asphalt became insoluble when exposed to light. In 1826 he heard about Louis Jacques Daguerre who was also trying to obtain permanent pictures by the action of sunlight and chemical agents. Daguerre was well known both as a physicist and a scene painter who had a remarkable faculty in representing light and shade and using lights to heighten effects. The two worked together to produce "heliographic" pictures, using metallic plates coated with asphalt and oil of lavender. After being exposed to the sunlight, this film remained undissolved when plunged into a mixture of petroleum and oil of lavender and the image was developed by the action of acids and other chemicals on the exposed plate. Niepce died in 1833 and Daguerre continued until he perfected his process known as the Daguerreotype. This consisted of five operations, the polishing of the silver plate, the coating of the plate with silver iodide by putting it in iodine vapor for twenty minutes, the projection of the image of the object upon the golden colored surface, the development of the latent image by mercury vapor, and finally the fixing of the picture by immersing the plate in a solution of hypo. In 1839 the French government paid a royalty on the process, on the condition that the Academy be told the process so that it might be published. The process has been changed very little by those making Daguerreotypes. This process was very popular and the pictures very beautiful but it took a long time to produce a picture. Often the subject had to sit for ten minutes in the sunlight in order to impress the plate. Unsuccessful attempts were made to find chemicals which would be more sensitive to light. In all these methods the sunlight had to do all the work in producing the image. Further experiments were carried out to find methods by which the

light could be used for the exposure and chemical agents could be used to produce the image.

William Fox Talbot in 1841 discovered he could develop a faint or invisible image. He prepared paper with silver iodide and exposed it. Only a faint image was visible. Then he washed the paper in a solution containing silver nitrate and gallic acid, which deposited the silver where the light had acted and built up the faint image into a strong picture. Then Talbot perfected a process by which he could print this negative on paper covered with silver chloride. He made the paper transparent by treating it with oil and wax so that he could print from it. The next process discovered was known as the wet collodion process. It was used by the photo-engravers for making the negatives from which they engraved the metal plates.

Collodion was made by dissolving nitrated cotton in an ether alcohol mixture. The wet collodion plates had to be made just before the picture was to be taken. First the photographer cleaned a piece of glass, then he coated it with collodion in which the chemicals were dissolved. The plate was put in a silver nitrate bath, forming silver iodide in the collodion film and making it sensitive to light. The wet plate was immediately put in the camera and exposed. Then it was developed, fixed and dried. At this time the photographer had to carry all his equipment including a folding tent which was dark except for a yellow or red window through which filtered light came in so that he could see to make the plates and develop them. The gelatin emulsion process was not developed until 1871 by Dr. Maddox. At first the emulsion was sold in a dry form, ready to be melted in hot water and coated on the plates. In 1873 Burgess conceived the idea of preparing the gelatin emulsion on the plates and selling them.

Thus we see that Clerk Maxwell had very limited photographic equipment for preparing color pictures. He based his theory of the photographic recording of colors on the three color sensation curves of Young Helmholz. Maxwell wrote: "This theory of color may be illustrated by a supposed case taken from the art of photography. Let it be required to ascertain the colors of a landscape by means of impressions taken on a preparation equally sensitive to rays of every color. Let a plate of red glass be placed before the camera, and an impression taken. The positive of this will be transparent wherever the red light has been abundant in the landscape, and opaque where it has been wanting. Let it now be put in a magic lantern along with the red glass, and a red picture will be thrown on the screen. Let this operation be repeated with a green and a

violet glass, and by means of three magic lanterns let the three images be superimposed on the screen. The color on any point on the screen will then depend on that of the corresponding point of the landscape, and by properly adjusting the intensities of the lights, etc., a complete copy of the landscape, as far as visible color is concerned, will be thrown on the screen. The only apparent difference will be that the copy will be more subdued, or less pure in tint than the original. Here, however, we have the process performed twice—first on the screen, and then on the retina." Later, with the aid of Thomas Sutton, who arranged the photographic set up, the first color picture was made. I think Maxwell's description of this demonstration is well worth quoting "A bow made of ribbon, striped with various colors, was pinned upon a background of black velvet, and copied by photography by means of a portrait lens of full aperture, having various colored fluids placed immediately in front of it, and through which the light from the object had to pass before it reached the lens. The experiments were made out of doors, in a good light, and the details were as follows:—First; A plate-glass bath, containing the ammoniacal sulfate of copper, which chemists use for the blue solution in the bottles in their windows, was first placed immediately in front of the lens. With an exposure of six seconds a perfect negative was obtained. This exposure was about double that required when the colored solution was removed. Second; A similar bath was used, containing a green solution of chloride of copper. With an exposure of twelve minutes not the slightest trace of a negative was obtained, although the image was clearly visible on the ground-glass. It was, therefore, found desirable to dilute the solution considerably; and by doing this, and so making the green tinge of the water very much paler, a tolerable negative was eventually obtained in twelve minutes. Third; A sheet of lemon-colored glass was next placed in front of the lens, and a good negative obtained with an exposure of two minutes. Fourth;

A plate-glass bath, similar to the others, and containing a strong red solution of sulfo-cyanide of iron was next used, and a good negative obtained with an exposure of eight minutes. It is impossible to describe in words the exact shades of color, or intensity of these solutions. The thickness of the fluid through which the light had to pass was about three-quarters of an inch. The collodion was simple iodized, the bath neutral, and the developer pyrogallic acid. The chemicals were in a highly sensitive state, and good working order, producing clean and dense negatives, free from stains and streaks in all cases. The negatives taken in the manner described were printed by the tannin process upon glass and exhibited as transparencies. The picture taken through the red medium, was

at the lecture illuminated by red light—that through the blue medium by blue light, and that through the yellow medium, by yellow light, and that through the green medium, by green light;—and when these different-colored images were superimposed upon a screen, a sort of photograph of the striped ribbon was produced in natural colors."

This note is extremely interesting as it proves that Clerk Maxwell did not adhere to the three-color principle in the practical execution of his theory, although the reason is not quite clear, nor is the purpose of the yellow-screened transparency; unless it was to supplement the green picture. All subsequent attempts at color photography are based on this discovery of Clerk Maxwell. One exception is the theory propounded by Professor Lippman, namely; that colors were produced by stationary light waves and interference colors. The theory was of no practical value but of great scientific interest. The next step in photographing in color was first recorded by Ducas du Hauron in 1862. When only twenty-five years of age he wrote a paper entitled "The solution of the problem of reproducing colors by photography." Hauron sent this paper to M. Lelut, a friend of the family, asking that he call it to the attention of some of his fellow members of the Academy of Science. In the paper he held that the three simple colors, red, yellow and blue could be separated photographically and recombined into one picture. He described a photogromoscope to do this, an additive method and also the screen-plate process. Lelut, after consulting one of his fellow members decided that the paper ought not to be presented, as there was no proof of the correctness of the arguments. This was later published; but Hauron received little encouragement and was unable to put his theories into practice. However he did make the first carbon process color photograph. He used three sheets of mica. Each was covered with dichromated gelatin and printed through the uncoated side. H. W. Vogel discovered that anilin dyes had a sensitizing action on silver plates. Advances along this line were made by Von Hubl, Abney and Eberhard. Among the first ones to successfully reproduce in color by photography were Professor Joly of Dublin and MacDonough in the United States. Joly is usually given priority but MacDonough patented his shellac-grain screen plate process in 1892. Joly brought out his process of the line screen plate in 1894. Very soon after this the Lumière brothers invented their starch grain process, which was not put on the market until 1907. The Thames screen plate process was modified and improved by the Paget process and put on the market in 1913. In 1916 the Agfa process was produced in Germany and later, in 1924, reintroduced. The first color process on roll and flat film was

produced by the Lignose color screen film. Due to the difficulty of developing this film it did not last long on the market. There are many problems of color photography which have not been solved as yet. I am not going into any more details about the history but will review some of the principles or theory underlying the process of making pictures in color and then outline a few of the most popular methods used today. Light is known to consist of waves. The color of light is connected with the length of the waves. The length of a light wave is the distance from the crest of one wave to the crest of the next. The unit of measurement of light is the Angstrom Unit (A.U.) which is one ten-millionth of a millimeter.

White light is a mixture of all the known colors. It is not an absence of color but a presence of all colors. Color is not a property of an object alone, but is dependent upon the presence of light. It is the result of the absorption and transmission or reflection of light. Objects appear colored because they absorb some of the rays of light falling upon them and reflect others. Transparent objects such as glass or gelatin absorb part of the light falling upon them and transmit the rest. This is the principle of the filters used in color photographing.

The eye has probably four types of optic nerves which are sensitive to blue-violet, green, red and yellow. Each color of the spectrum excites these nerves in varying degrees. Formerly it was thought there were only three types of optic nerves, namely; those sensitive to blue-violet, green and red, but there is probably a fourth sensitive to yellow, as red and green are more brilliant than two thirds white, and yellow and black are more brilliant than white and black. When these excitations are mixed they convey to the brain the effect of any spectrum color or blending of these colors. The visible spectrum represents wave lengths of from 3,400 A.U. at the blue violet end, to 7,000 at the red end. The photographic plate may be made sensitive to portions of the spectrum invisible to the eye, that is the infra red which extends beyond the red end. The ultra violet rays are beyond the violet end.

Photographic materials have advanced and are still advancing at a great rate and what may be said to be the most perfect method today, may be improved upon by a newer method tomorrow. Since the photographic plate or film can be made sensitive to any color in the spectrum, and is not equally sensitive to them all at once, special methods have been developed for photographing just what one wishes to reproduce. Before discussing the processes employed we should call to mind the three primary colors, red, green, blue and the complementary color of each, namely; blue green,

magenta and yellow. The three primaries produce white light and the complementaries are produced by mixing any two of the primaries, as red and blue produce magenta, blue and green produce blue green and red and green produce yellow.

There are two processes of color synthesis, namely; the additive and the subtractive.

The additive color synthesis consists of adding together the light rays of the primary colors, red, green and blue, to produce white by their total addition, black by their absence and any color by varying the amounts of these three. A color picture made by the additive process would be produced by making three positive transparencies in which the high lights or transparent portions represent the red, green and blue in the original, and superimposing these by projection upon a white screen using red light for the red transparency, green for the green, and blue for the blue transparency. In other words we superimpose the light rays from three positives, red and black, green and black and blue and black, to produce a picture in all variations of color. This process is used only for transparencies.

In the subtractive color synthesis, the colors are produced by a different method. This method may be used for either transparencies or prints. Three separation negatives are taken each through a filter of a primary color, namely: red, green and blue. Then a positive is made of each negative. These are colored by the color complementary to it. Then these three colored positives are superimposed and the original picture is reproduced in color. In making a three color print we regard the white paper stock upon which the print will be built as the light source.

There are a number of films on the market which utilize one or the other of these processes. The screen plate or additive process consists of two distinct types, the combined and the duplicating. The combined may be divided into several types, the autochrome, perfected by the Lumière Brothers, the Agfa, the Dufay color film and the Kodachrome.

In the Lumière or Autochrome process the mosaic screen is composed of starch granules. The plate is prepared from potato starch grains. The grains are sifted until granules varying from 0.015 to 0.020 mm. are collected. These are dyed in three lots, red, green and blue-violet. A mixture of these colored granules are spread on glass plates which have been coated with a sticky substance. The surface is brushed off and the plate is covered with colored granules which touch but do not overlap. The spaces are

filled with black powder. The granules are flattened under pressure and then the surface is coated with varnish. A thin panchromatic emulsion is then spread over the surface. To protect the finished emulsion a black card is placed in contact with it. This is kept here until the plate is developed. The plate is loaded in the camera with the glass side to the lens. These plates are slow.

The Agfa film is prepared by coating the plate with an emulsion of mixed dyes. The dyes are made by dying gum solutions of the three primary colors which have been made up in mediums which do not mix with one another. The coating dries down into very small dots of gum. These are about the same size as the starch granules mentioned above. There are about three million of them per square inch. There are no spaces between the dots of color so no black powder is used and the mosaic is more transparent than that made with starch granules. A fast emulsion is coated on, and the finished plate is twice as fast as the Lumière.

Dufay color film is made by coating film with an emulsion containing the three primary colors dissolved in it. After exposure a direct positive colored transparency is obtained. First the film is developed to a negative. Then it is bleached dissolving the black silver image formed during development leaving a white silver bromide positive image. This is exposed to light and a positive colored transparency results.

Kodachrome film perfected by Eastman, is prepared by superimposing several layers of dyes in an emulsion. One layer acts as a filter for the next. The developing of this film is very intricate and best results are obtained by sending the film to the manufacturer to be processed. By a general process a positive colored film results.

The Finlay color plate process is an example of the duplicating process of the additive method. When taking a picture a taking screen is placed in front of the negative plate with the emulsion. The taking screen has a mosaic of very tiny squares of red, green and blue. The squares on the taking screen and the emulsion on the negative must be held together very tightly. After exposure the positive plate is printed. This is then registered with a viewing screen and fastened very tightly so that a perfect colored image presents itself. Finlay also has a positive color screen which is a positive emulsion and viewing screen combined on one plate. The negative and this plate are registered, clipped together and exposed. The positive color screen is developed and a perfect colored image is seen. There is no parallax effect in this picture such as may result from registering a positive plate and a viewing screen.

There are a number of popular methods included in the subtractive color synthesis process. Included are the Chromatone, Wash-off Relief, Autotype trichrome carbro, Belcolor printing film, autotype Dyebro reliefs, Duxochrome and Colorstill process. Both transparencies and prints may be prepared by the subtractive processes.

The principle of the subtractive process is that the colors subtract from the white light falling on them. Three balanced exposures of the same subject made, one through a red filter, one through a green filter and one through a blue filter, will record the color proportions of that object in a black and white negative. Then positives are made and dyed the color, complementary to the color of the taking filter. These three dyed positives are superimposed in register and produce the original picture in color. The three-color separation negatives must be of similar contrast, called gamma. This is controlled by using fresh developer of correct temperature and developing the proper time.

There are several different ways of making three-color separation negatives. 1. Three separate exposures may be made, changing both the films and filters before each exposure. Any camera may be used. One type of film, i.e., a Panchromatic may be used and the filters, A. B. C changed each time, or three different films may be used, namely XF Panchromatic film with the red filter, X.F. Ortho film with the K-5 filter and Blue Record film with no filter. The filter may be placed in front of the lens or behind the lens, according to the type of holder used. To produce the same contrast, the time of exposure and developing is varied with the filter and film used. 2. A sliding back may be used and the three filters and films are changed automatically, the lens shutter being closed each time the film is moved. 3. Instead of changing the films, a "one shot" camera may be used. This may be of the single or double mirror type. This is the most perfect way of making separation negatives as the colors are accurately and automatically separated simultaneously and rapidly. The double mirror type uses three separate films, the single mirror type uses two film holders one loaded with two films, the other with one. 4. Tri-pac film may be used, taking all three exposures at once, using an ordinary camera. The front film is sensitive to blue only and contains yellow dye so that only green and red light reaches the second film which has been sensitized to green but not to red. The back of the second film has a red coating so that only red light will pass through to the back film which is panchromatic, non-halation backed. This is a very satisfactory way to make three-color separation negatives except when

very fine detail is required, as in photomicrographs and small specimens.

After the three separation negatives are made, the positives made from them are printed in the complementary color. The exposure made through the orange-red, commonly called the A filter, Wratten No. 25, absorbs (does not record) the blue and green light and the positive is printed in the complementary blue-green. The positive from the exposure made through the green filter, B, or Wratten No. 58 which absorbs the red and a portion of the blue light is printed in the complementary magenta. The positive from the exposure made through the blue-violet, C-5, or Wratten No. 47 filter which absorbs the yellow light is printed in the complementary yellow.

I shall discuss the details of two methods, namely: the Defender Chromatone and the Eastman Wash-off Relief processes.

In the Chromatone process the positive prints may be made from the three separation negatives either by contact or by projection. The positives are made on special collodion stripping paper. Special toning solutions are used to convert the silver image into the respective blue-green, magenta and yellow images. The prints are fixed in the usual standard fixing bath, washed, bleached, washed and then toned. Then the colored prints are assembled one above the other in register on a piece of backing paper which has been laid face up on a sheet of masonite, fastened with paper gum tape and allowed to dry. Transparencies are made by assembling the colored prints on a fixed-out plate.

The Eastman Wash-off Relief process is one of the so-called imbibition processes as it uses dyed gelatin relief positives for transparencies and the dye is transferred to paper for color prints. The positives are made from the three separation negatives by contact or projection onto a relief film. This is developed, fixed, bleached, washed out to develop the relief, and dyed. If prints are to be made a dyed relief is placed dye side down on a piece of fixed gelatin paper and squeegeed. A piece of plate glass is placed on top to keep the relief in close contact with the paper and to keep it from drying out. In about thirty minutes this relief is removed and the second and third dyed reliefs are superimposed in a similar manner. The print is then dried. If transparencies are to be made, the dyed reliefs are dried and then mounted between glass.

The colors of the prints and transparencies made by these methods seem to be permanent. They make very good lantern slides. These methods are especially applicable to photomicrographs.

THE USE OF AMMONIA VAPOR IN THE PREPARATION OF HISTOLOGICAL SLIDES

By THERESA CULP, M.T.

From the Laboratory of Drs. Barret and Summerville
Charlotte, North Carolina

During the process of routine staining of paraffin or other sections, using the hematoxylin-eosin method and an albumen fixative, the usual procedure after staining with hematoxylin and washing with water is to remove the excess hematoxylin by immersing the slide in a dilute solution of hydrochloric acid until the proper degree of decolorization has been obtained. After washing in water to remove the excess acid, this step is followed by immersion in dilute ammonia water to neutralize the acid and then a second washing in water to remove the excess ammonia. Those who are familiar with this common technique have often encountered the disagreeable exprience of failure of the sections to remain on the slide, especially when the section consists of small bits of tissue such as are usually obtained in uterine curettings; however, this trouble is not confined entirely to small sections. Though the failure of sections to remain on the slides can occur with any size section and can occur at any stage of the staining process, these failures are usually due to improper drying, improper fixation, etc. The point at which separation from the slide most commonly occurs in our experience is in the ammonia bath and the washing which follows. We have found by experience that this trouble is almost completely eliminated by the use of ammonia vapor rather than by the use of dilute ammonia water. Our routine procedure is to use a few drops of dilute ammonia water in the bottom of a Coplin or other staining jar. In this way the slides are put into a dry or almost dry staining jar, and no liquid touches the section on the slide. By using weaker or stronger ammonia solutions, the process of neutralization of the acid may be made as slow or as fast as the individual desires, though we have found it undesirable to place sections in a very strong ammonia vapor as the subsequent washing out of ammonia requires a longer time. We do not state the exact amount of ammonia necessary for this step as we believe that each technician will wish to work out that detail more satisfactorily according to his own requirements. At present we are using 2 c.c. of a 1% solution of strong ammonia. This is placed in the jar and allowed to stand a few minutes with the top closed before the slides are put into the jar. In this way

the jar is filled with the weak fumes of ammonia before the slides are put into it. If a number of slides are being stained, which necessitates frequent opening of the jar, it may be necessary to replenish the supply of dilute ammonia water. We have found that the use of a very strong solution of ammonia with this method may be harmful to the sections in the same way that a strong ammonia or other alkali solution acts when the usual method is employed.

Although we have used this method on hundreds of slides, we have not lost a single section from the slides. In our experience this very simple procedure has been a decided time saver as well as an improvement in general technique, and for this reason we are reporting it.

NEWS AND ANNOUNCEMENTS

Excerpts from a letter received from Mr. Aubrey E. P. Grimmo, a registered Medical Technologist, who is connected with the Shanghai Municipal Council, Public Health Department:

"The Sino-Japanese 'War' has brought about many changes in this city and I fear that more serious reactions are yet to follow. Our personal safety is, at least for the time being, more certain. In view of the possibility of further repercussions, it may become necessary for me to find a new environment in which to live and work. One of my ideas at the moment, presuming that it is possible to register with an American university as a foreign student, is the ambition of studying for a degree in Medicine or Medical Technology.

"Before closing, it may interest you to know that this laboratory has had an exceptionally heavy summer's work. The presence of large numbers of refugees increased the normal spread of dysenteries and the like, and was particularly unfortunate because this has been a Cholera year. Not only the above, but in addition we were very short staffed due to sickness and leave. However, it is gratifying to know that the job has been well done.

(*Supplied through courtesy Mrs. Anna R. Scott, The Registry of Medical Technologists*)

"Public Health in the World of Tomorrow" is the central theme of the 67th Annual Meeting of the American Public Health Association to be held in Kansas City, Mo., October 25-28.

Recognizing that the responsibilities of the health official have expanded by sheer force of necessity into fields of diagnosis and treatment, considered in the very recent past as beyond the circle of health department obligations, the program of the Association's 67th convention will attempt to look around the corner and see what's ahead for the career man or woman in the public health profession.

It is agreed in Association councils that the advance in public health has been so rapid in the last half dozen years that a clarifica-

tion of current objectives and policies is urgently needed. The convention will sound that note at the beginning of its deliberations, getting under way with a session devoted to a discussion of the present state of the health of the nation. Thereafter, the central theme, "Public Health in the World of Tomorrow" will be emphasized throughout the several days of meetings.

The American Public Health Association is a society of professional public health workers. Its membership numbers nearly 6000 and includes health officers, laboratory workers, vital statisticians, industrial hygienists, child hygienists, public health engineers, food and drug experts, health educaton authorities, nurses, epidemiologists and others who specialize in disease prevention and health promotion.

An attendance of 3000 is expected at the Kansas City Annual Meeting drawn from every state in the Union, from Canada, Cuba, Mexico and from abroad.

The American Association for the Study of Goiter, pursuant to its accepted invitation and to correspondence with the Honorary Presidents and Attending Members of the First and Second International Goiter Conferences, announces that the Third International Goiter Conference is to convene in the city of Washington, District of Columbia, U. S. A., September 12 to 14, 1938.

The subjects proposed for discussion are as indicated in the outlined tentative program enclosed.

Physicians and others in the United States and in other countries desirous of participating in the program are requested to submit titles at their earliest convenience. Since the time which it is possible to allocate on the program is obvously limited, it will be necessary for the Program Committee to exercise its best judgment in the selection of speakers and to insist without exception that the speakers conform to the time allocated.

Manuscripts of addresses, papers and discussions delivered or read at the meetings are to be published in extenso in the form of transactions.

The official language of the Conference shall be English. Interpreters will be furnished for papers read in other languages.

For further information concerning the Conference, communicate with the officers of The American Association for the Study of Goiter or the Chairman of the Program Committee.

This year as a part of the City Health Conservation Contest conducted annually by the Chamber of Commerce of the United States in cooperation with the American Public Health Association awards are being made for the most effective community wide programs for Syphilis Control and Tuberculosis Control. On April 22nd, the winners of the Ninth Annual City Health Conservation Contest were announced.

Today the committee of health experts known as the Grading Committee announces the following winners in the Syphilis Control Contest:

First award goes to Tacoma, Washington, with awards of merit going to Hartford, Conn., Newark, N. J., Louisville, Ky., and New Haven, Conn.

In the Tuberculosis Control Contest, the winner is Detroit, Michigan, with awards of merit going to Newton, Mass., Hartford, Conn., aud New Haven, Conn.

A few of the items considered by the committee were: The comprehensiveness of case-finding and follow-up services in connection with tuberculosis and syphilis, the facilities provided for dianostic and treatment purposes, and the extent of group participation in programs of education and control.

These and many other items were carefully considered by the committee of health experts in judging the effectiveness of a city's efforts to combat tuberculosis and syphilis.

BOOK REVIEWS

APPROVED LABORATORY TECHNIC by John A. Kolmer, M.D., Dr. P.H., Sc.D., LL.D., L.H.D., F.A.C.P., Professor of Medicine, Temple University; Director of the Research Institute of Cutaneous Medicine, Philadelphia; formerly Professor of Pathology and Bacteriology, Graduate School of Medicine, University of Pennsylvania; and Fred Boerner, V.M.D., Assistant Professor of Bacteriology, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Bacteriologist, Graduate Hospital, Philadelphia; with 28 Contributors and Collaborators. Second Edition. Pp. 893, 12 plates and 380 illustrations. Publishers, D. Appleton-Century Company, New York. Price $8.00.

The clinician of today has become inseparably bound to the laboratory as his chief diagnostic and therapeutic assistant. The most accurate laboratory methods available, therefore, should always be the ones employed. Most diagnostic mistakes in medicine are made through errors of omission. A wider and more intelligent use of the laboratory would undoubtedly make for a much higher percentage of correct diagnosis.

In the second edition of this work the technic of the methods given have been approved not only by a committee of the American Society of Clinical Pathologists but by a group of twenty-eight outstanding collaborators and, in many instances, by the authors of methods themselves. Each chapter has been thoroughly revised and the majority rewritten with the addition of five new chapters.

Section I includes three chapters taking up the microscope and methods of micrometry, methods for housing, feeding, inoculating, etc., of animals, the diagnosis of animal diseases and the prevention and treatment of laboratory accidents. Section II of eleven chapters deals with clinical pathological methods for the examination of blood, urine, kidney function, sputum, stomach contents, bile, liver function, feces, exudates and transudates, cerebrospinal fluid and a new chapter by Davidsohn and Reinhart on methods for the hormonal diagnosis of early pregnancy, hydatidiform mole, chorionepithelioma and teratoma of the testicle. Section III on bacteriological methods includes eleven chapters on methods for the collection of specimens, preparation and sterilization of glassware and culture media, general and diagnostic bacteriological methods, new chapters by Gault on diagnostic mycology and examination of skin and mucocutaneous membranes for animal parasites, preparation of bacterial vaccines and bacteriophage, bacteriological exam-

ination of milk and water and the testing of disinfectants. Section IV of six chapters takes up serological methods for the collection of blood and serum, agglutination and pretransfusion blood tests, complement-fixation tests for syphilis and other diseases, precipitation tests and a new chapter by Tuft on tests for allergy. Section V of seven chapters is devoted to chemical methods of colorimetry, nephelometry and scopometry, preparation of standard volumetric solutions, blood chemistry, basal metabolism, examination of milk and other foods, toxicilogical examinations and a new chapter by Konzelmann on methods for the microscopical examination of tissues and the preparation of museum specimens.

Technics are given in a concise manner but with sufficient detail to guard against technical errors. Two or more well selected methods are given in many instances which furnish alternate methods for controls. Physicians, teachers, clinical pathologists, medical students and laboratory technicians alike will find this second edition of Kolmer a most helpful and instructive aid and guide to their diagnostic and laboratory problems.

A TEXTBOOK OF HEMATOLOGY by William Magner, M.D., D.H.P., Pathologist Saint Michael's Hospital, Toronto, Canada; Lecturer in Pathology, University of Toronto; Formerly Lecturer in Pathology, University College, Cork, Ireland. Pp. 395. Publishers, P. Blakiston's Son & Co., Inc., Philadelphia. Price $4.50.

The first six chapters of this work take up in order the origin of the cellular elements of the blood, the bone marrow and extramedullary hemopoiesis, the erythrocytes, platelets, leucocytes and hemoglobin and its derivatives. Chapter seven is devoted entirely to laboratory methods. The remaining ten chapters describe the various anaemias, polycythemia vera and the leukemias.

The work is beautifully written. Even though one is not a hematologist the subject matter is so clearly presented and readable that a knowledge of hematology and the blood dyscrasias is offered as if on a silver platter. The busy practitioner, encountering as he does the various forms of anemia and an occasional leukemia, will find that a half hour a day spent in the pleasurable reading of this book will be repaid many fold in his increased knowledge of hematology, whether he is already well acquainted with the subject or not. As the author states there is no short cut to a knowledge of hematology and one should not consider himself well equipped for the diagnosis of blood diseases by simply providing himself with an atlas of hematology. An understanding of normal hemopoiesis is essential in the interpretation of pathological blood pictures and the

author has accordingly devoted considerable space to this topic and to the etiology of the various blood diseases.

A HANDBOOK OF ACCEPTED REMEDIES by P. J. Hanzlik, M.D., Professor of Pharmacology, Stanford University School of Medicine, San Francisco, California. Second Edition. Publishers, J. W. Stacey, Inc., Flood Bldg., San Francisco. Price $1.00.

A handy reference booklet of symptoms and treatment of poisoning, diagnostic procedures and miscellaneous information, this loose leaf work of 108 pages contains much useful material quickly available. A table showing the normal range of various blood, cerebrospinal fluid and urine constituents and the pathological range is not usually found in textbooks on these subjects. Suggested methods for the calculation of doses for man from known doses in animals; nomogram for body surface; formulae for standard error and for therapeutic problems; fatal doses of important drugs; a table of vitamins and vitamin products; drugs and chemical substances excreted in the urine and others which interfere with urine tests; number of drops in a fluid drachm of various liquid preparations; these are just a few of the many items picked at random in this small but useful booklet.

ABSTRACTS

"DANGEROUS" UNIVERSAL DONORS: E. Balgairies and L. Christiaens. Écho Médical du Uord, Lille. 7:649, May 16, 1937.

Blood transfusions particularly from certain universal donors (group O) may be injurious because richness in agglutinins or antibodies, the latter being determined by Schiff's centrifuge technique which is described in detail.

SULFHEMOGLOBINEMIA AND METHEMOGLOBINEMIA AFTER SULFANILAMIDE. J. P. J. Paton and J. C. Eaton. Lancet, London, 1:1159, May 15, 1937.

In the detection of sulfhemoglobinemia spectroscopic examination of the blood is a more delicate means than clinical observation of cyanosis.

CLINICAL SEROLOGIC INVESTIGATIONS ON TUBERCULOSIS AND ARTICULAR RHEUMATISM. R. Brandt and H. Kutschera von Aichbergen, Beiträge zur Klinik der Tuberkulose, Berlin. 89:411, May 22, 1937.

Antigen-antibody reactions were done on 1,179 cases under hospital control. In tuberculosis the reactions are negative for the first few weeks and then become positive and remain so as long as active disease exists. A negative or weak reaction in progressing disease indicates poor prognosis. Acute rheumatic polyarthritis gave the same immunobiologic findings. The authors accept the theory of the tuberculous origin of acute rheumatic polyarthritis.

THE EFFECT OF FRUCTOSE ON THE GLUCOSE TOLERANCE CURVE: J. P. Fletcher and E. T. Waters. Biochem. Jour., vol. 32, No. 2, Feb., 1938, p. 212.

The authors describe their experiments in injecting fructose and galactose into normal and depancreatized dogs. Fructose was found to depress the glucose tolerance curve markedly while galactose had no effect.

Contrary to previous reports, the injection of fructose does not increase the available insulin but, probably acts as a catalyst in the utilization of glucose in the process of glycogenesis in the liver.

AN IMPROVED METHOD FOR THE COLORIMETRIC DETERMINATION OF PHOSPHATE: I. Berenblum and E. Chain. Biochem. Jour., vol. 32, No. 2, Feb., 1938, p. 295.

Description of a standard method and a micro method for phosphate which the authors state is very nearly independent of interfering substances.

THE ANALYSIS OF CALCIUM IN BLOOD AND OTHER BIOLOGICAL MATERIAL BY TITRATION WITH CERIC SULFATE: C. E. Larson and D. M. Greenberg. Jour. Biol. Chem., vol. 123, No. 1, Mar., 1938, p. 199.

The authors give a method for calcium using ceric sulfate instead of permanganate.

BACTERIOSTATIC ACTION OF SULFANILAMIDE UPON MENINGOCOCCUS IN SPINAL FLUID: E. Neter. Proc. Soc. Exp. Biol. and Med., vol. 38, No. 1, Feb., 1938, p. 37.

Report of experiments in which spinal fluids containing Meningcocci were treated with dilutions of sulfanilamide and cultured. Growth was inhibited by the drug but, the author cautions against assuming a parallel in vivo.

THE USE AND INTERPRETATION OF TESTS FOR LIVER FUNCTION: A. M. Snell and T. B. McGath. J. A. M. A., vol. 110, No. 3, 1938, p. 167.

A review of the various procedures used to demonstrate disease of the liver with a discussion of their application and limitatons.

EFFECT OF PRONTOSIL ON BLOOD CELLS: W. Kreutzmann and J. L. Carr. Proc. Soc. Exp. Biol. and Med., vol. 38, No. 1, Feb., 1938, p. 19.

0.25 gm. prontosil per kilo body weight was given to rabbits for 21 days. They showed no numerical change in blood cells but an increase in stippled red blood cells and eosinophiles suggesting mild bone marrow depression. There was also congestion of the spleen and an increase in eosiophi'es in the bone marrow also pointing toward a bone marrow depression.

THE DETERMINATION OF SULFANILAMIDE IN BIOLOGICAL MEDIA: J. V. Scudi. Jour. Biol. Chem., vol. 122, No. 2, Jan., 1938, p. 539.

The author reports various other methods as non-specific or not sufficiently sensitive for the ordinary concentrations and therefore unfit for quantitative determinations. He gives a colorimetric method for blood using the Folin-Wu filtrate and chromotropic acid. There is also an adaptation for urine.

GRANULOCYTOPOIETIC FRACTION OF YELLOW BONE MARROW: C. M. Marberg and H. O. Wiles. Arch. Int. Med., vol. 61, No. 3, Mar., 1938, p. 408.

The authors present the method employed in concentrating the granulocytopoietic fraction of bone marrow and outline its use experimentally in the treatment of agranulocytosis. The concentrate was found to stimulate maturation or liberation of leucocytes of the granulocytic series with coincident clinical recovery of uncomplicated cases.

AMERICAN SOCIETY OF MEDICAL TECHNOLOGISTS

Program of the Sixth Annual Convention

Headquarters

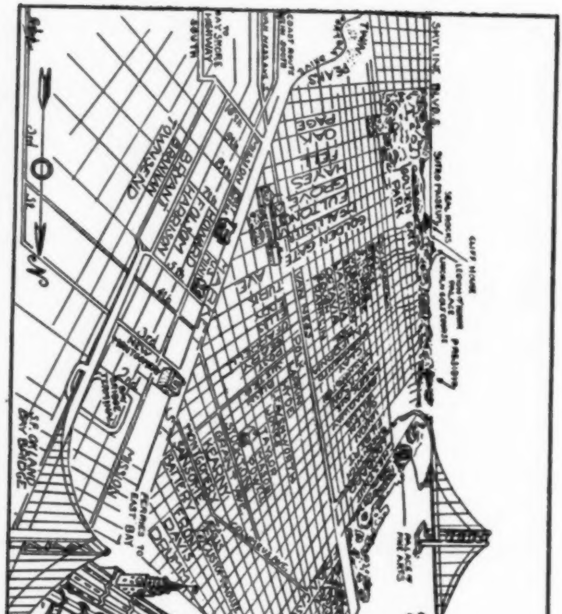
YOUNG MEN'S INSTITUTE BUILDING

50-70 Oak Street

San Francisco, Cal.

JUNE 13-14-15

1938



MAP OF SAN FRANCISCO

General Chairman Program Committee

BERNICE ELLIOTT, 5107 Webster St., Omaha, Neb.

Chairman Scientific Exhibits

MARY M. GORGAS, 2916 Steiner St., San Francisco, Cal.

Local Arrangements

ARTHUR T. BRICE, East Road, Ross, Cal.

SOCIAL ACTIVITIES

Daily announcements will be made pertaining to the social entertainments.

WEDNESDAY EVENING, JUNE 15

Sixth Annual Banquet, 6:30 P. M.
Richelieu Hotel, Van Ness Ave. at Geary St.

AMERICAN SOCIETY OF MEDICAL TECHNOLOGISTS

SIXTH ANNUAL CONVENTION

Headquarters,
Young Men's Institute Building,
50--70 Oak St.

June 13-14-15, 1938

REGISTRATION: June 13, 8 A. M. to 12 M.

EXHIBITS: Open 12 M. to 2 P. M.—4 P. M. to 8 P. M. Daily.

MONDAY, JUNE 13, 9 A. M.

EXECUTIVE SESSION

INVOCATION

MINUTES OF 1937 CONVENTION

APPOINTMENT OF COMMITTEES

ANNOUNCEMENTS

PRESIDENT'S MESSAGE—Frieda Ward, Newark, N. J.

REPORTS:

Executive Committee — Luella Gifford, Chairman

American Journal of Medical Technology John H. Conlin

Membership—John H. Conlin

Advisory Board—Phyllis Stanley, Chairman

Counsellors—Harry Macko, Chairman

Treasurer—Hermine Tate

ADOPTION OF REPORTS

NEW BUSINESS

MONDAY, JUNE 13, 2:00 P. M.

Presiding—HENRIETTA LYLE

1. "Recent Improvements in the Quantitative Estimation of Blood Sugars," GEORGE MICHAELS, Ph.D., Samuel Merritt Hospital, Oakland, California. Twenty minutes.
2. "The Determination of Cystine in the Nails," DR. ZERA BOLIN, San Francisco, California.
3. "The Relation of Serum Cholesterol to Basal Metabolism Rate," MARIAN BAKER, M.T., Hamilton Hospital, Olney, Texas. Twenty minutes.
4. "Technical Studies in Normal Children's Lungs," DR. MIRIAM BENNER, Fellow in the Child Research Council, Denver, Colorado. Twenty minutes.
5. "Tissue Staining," LORAN P. WILLIAMSON, M.T., San Antonio, Texas. Twenty minutes.

MONDAY EVENING, JUNE 13

Social activities to be announced.

TUESDAY, JUNE 14, 9:00 A. M.

Presiding, SR. M. JEANNETTE BODOH

1. "Basophilic Aggregation," DR. ROBERT A. GLENN, Samuel Merritt Hospital, Oakland, California. Twenty minutes.
2. "Bacteriology in the Smaller Laboratory," DR. J. L. LATTIMORE, Lattimore Laboratories, Topeka, Kansas. Twenty minutes.
3. "Analysis of Culture Reports on Studies of Biliary Drainage," ANNETTE CALLAN, M.T., Philadelphia, Pa. Twenty minutes.
4. "Value of Exact Bacteriological Determinations," ANN SNOW, M.T., University of Arkansas, School of Medicine, Little Rock, Ark. Twenty minutes.
5. "Type Incidence of Pneumococcus Infections in Oklahoma," IDA LUCILLE BROWN, M.T., University of Oklahoma, School of Medicine, Oklahoma City, Oklahoma. Twenty minutes.

TUESDAY, JUNE 14, 2:00 P. M.

Visit to the Laboratories of the Highland Hospital, Oakland, Cal.

TUESDAY EVENING, JUNE 14

Social activities to be announced.

WEDNESDAY, JUNE 15, 9:00 A. M.

Presiding—To be announced

1. "Normal Hematologic Standards," DR. ALVIN G. FOORD, Huntington Memorial Hospital, Pasadena, and University of Southern California, Medical School, Los Angeles, California. Twenty minutes.
2. "Problem of Blood Cultures," DR. ROBERT F. E. STIER, St. Luke's Hospital, Spokane, Washington. Twenty minutes.
3. "Studies in Experimental Dehydration," DOROTHY ASHER, M.T., The Children's Hospital, Philadelphia, Pa. Twenty minutes.
4. "A New Index of Respiratory Efficiency," ARTHUR T. BRICE, M.T., Lieutenant-Colonel, Infantry Reserve, U. S. Army, Ross, California. Twenty minutes.
5. "The Museum in the Small Hospital," PHYLLIS STANLEY, M.T., Presbyterian Hospital, Newark, New Jersey. Twenty minutes.

WEDNESDAY, JUNE 15, 2:00 P. M.

BUSINESS SESSION

ELECTION OF OFFICERS

WEDNESDAY, JUNE 15, 6:30 P. M.

SIXTH ANNUAL BANQUET

REGISTRATION

Members and guests are requested to register upon arrival. Registration, Young Men's Institute Building, 50-70 Ash St.

EXHIBITS

12 to 2 and 4 to 8 P. M. Daily

Admission will be limited to those wearing badges of the Society.

SCIENTIFIC EXHIBITS

1. Photomicrographs of leprosy, rhinoscleroma, bilharzia, ankylostoma, and amoeba. From Miss Spore, Assuit, Egypt.
2. Pneumococcal infections in Oklahoma—from the Oklahoma State Society, presented by Miss L. Brown.
3. Electrocardiogram of a Dying Human Heart, by A. Brice, San Francisco.
4. Blood film by Peroxidase technic, by Miss Hess and A. Brice, both of San Francisco.
5. Technique of Opsono-cytophagic, by E. Evans, of Washington, D. C.
6. Torula histolytica, by A. Snow, Little Rock, Ark.
7. Gastric lavages demonstrating T. B. in stomach contents, by J. Scott, Manitoba Sanatorium, Canada.
8. A case of Trichinosis in a young woman, recovery good, by E. B. Wehrle, Marion, Ohio.
9. The Calibration of Red Blood counting pipettes, by E. Elliott, Omaha, Neb.
10. The Museum and its place in a small hospital, by P. Stanley, Newark, N. J.
11. Tissues stained by various methods, L. H. Williamson, San Antonio, Texas.
12. Psittacosis, from the Univ. of California.
13. Posters, not classified, from Grace Ballard Mt. Sinai Hospital, Milwaukee, Wis.
14. Fungi and Poisonous plant, Academy of Science, San Francisco.
15. Typing plate, designed by A. Brice, from San Francisco and Mfg., by A. Thomas of Philadelphia.
16. Special Staining Technique on large sections, by Wm. A. Hewitt, Univ. of California, Dept. of Path.
17. Demonstrating Razor method on tissue, by Dr. Terry, Tacoma, Wash. (not definite).

TRANSPORTATION

SAN FRANCISCO MEETING

The round trip, first class fare, which will apply for the convention, to San Francisco via Chicago and the Santa Fe direct or Santa Fe to Los Angeles then Southern Pacific, returning the same or any other direct route, on basis of tariffs now in effect, is: From Chicago, $90.30; from Kansas City, Mo., $75.60; from Boston, $148.55; from New York, $141.50; from Philadelphia, $136.10; from Pittsburgh, $117.35; from Cleveland, $109.95; and from Buffalo, $120.40. Tickets are limited to three months in addition to date of sale, stop overs being allowed at all points enroute, both going and returning within the final limit. There are various return routes open to individual selection. Tickets may be routed returning via Portland and Seattle thence direct lines to Chicago without additional cost. To include the Canadian Rockies there will be an additional cost of $5.00.

Side trip, Williams, Arizona, to Grand Canyon, Arizona, and return is $7.00.

In many instances the above fares are less than former fares granted for conventions which were on basis of fare and one-third of the one way first class fare, prior to September 30, 1936. The use of convention fares has been discontinued in the territories of the Central Passenger, Trunk Line and New England Passenger Associations. No certificates of any kind will be necessary.

The Pullman fares from Chicago to San Francisco direct and via Grand Canyon are:

	Direct	Via Grand Canyon
Lower berth	$15.75	$18.75
Upper berth	12.60	15.00
Compartment	44.50	52.50
Drawing room	56.00	66.00

Pullman fares for the return journey will vary according to the route selected. As June is one of the busiest months in Passenger Traffic, would suggest making reservations at the earliest possible date.

For further information or reservations, confer with local ticket agent who will give more specific information regarding fares and routes.

HOTEL RESERVATIONS

A. S. M. T. SESSION

SAN FRANCISCO, JUNE 13-15, 1938

Hotel reservations should be made immediately through F. C. Warnshuis, M.D., Chairman, Hotel Committee, A. M. A., Suite 2004, 450 Sutter Street, San Francisco, California, stipulating price of room ($2.50-$6.00), whether single or double, and for what period of time. (Be sure to sign name and address.)